

# Retractable Robotic Anchor for Hard Rock and Granular Soils, Phase II

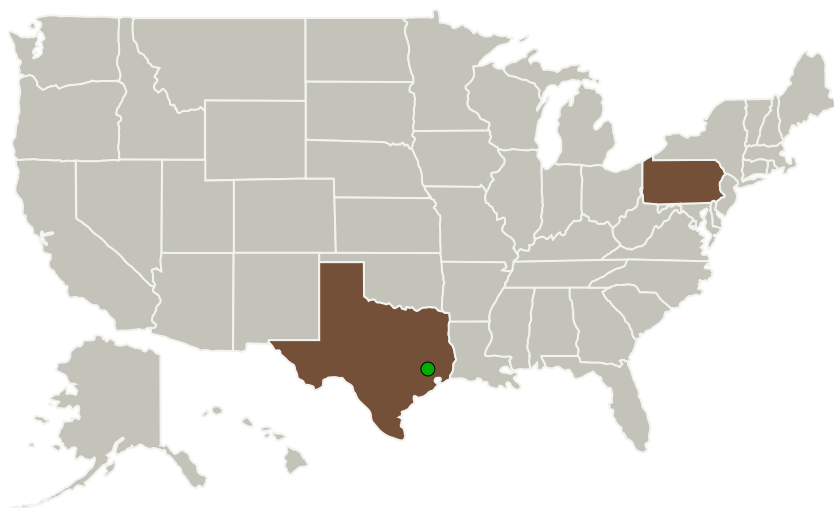
Completed Technology Project (2017 - 2019)



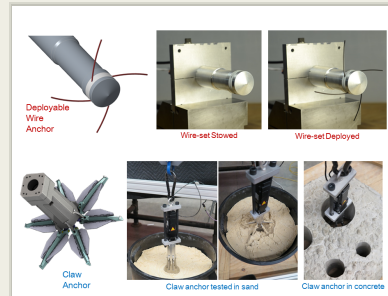
## Project Introduction

ProtoInnovations, LLC, is developing an innovative retractable robotic anchor that works in hard rock and granular soils permitting anchoring and subsequent repositioning of a lander, rover, or other equipment. Our primary goal is to support a number of mission targets to Mars, the Moon, and asteroids. This technology would be particularly useful for missions involving extreme terrain mobility, small body/microgravity mobility, and forceful interaction between a planetary surface system and its environment (e.g. drilling, digging, etc.) These missions are all ranked as High Priorities in NASA's Robotics, Tele-robotics, and Autonomous Systems Roadmap Technology Area 04 (April 2012).

## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Protoinnovations, LLC	Lead Organization	Industry	Pittsburgh, Pennsylvania
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas



Retractable Robotic Anchor for Hard Rock and Granular Soils, Phase II Briefing Chart Image

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## Primary U.S. Work Locations

Pennsylvania

Texas

## Project Transitions

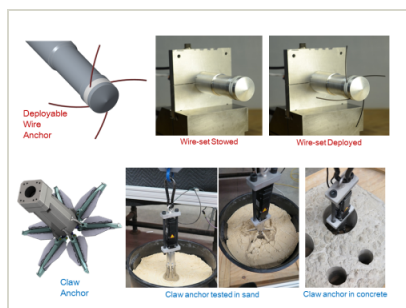
**April 2017:** Project Start

**April 2019:** Closed out

### Closeout Documentation:

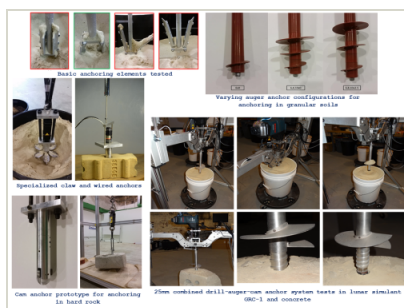
- Final Summary Chart(<https://techport.nasa.gov/file/140907>)

## Images



### Briefing Chart Image

Retractable Robotic Anchor for Hard Rock and Granular Soils, Phase II  
Briefing Chart Image  
(<https://techport.nasa.gov/image/130563>)



### Final Summary Chart Image

Retractable Robotic Anchor for Hard Rock and Granular Soils, Phase II  
(<https://techport.nasa.gov/image/127967>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Proteininnovations, LLC

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

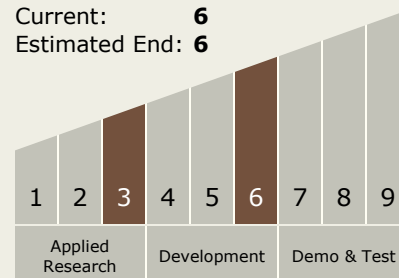
Carlos Torrez

### Principal Investigator:

Dimitrios Apostolopoulos

## Technology Maturity (TRL)

Start: 3  
Current: 6  
Estimated End: 6



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## Technology Areas

### Primary:

- TX04 Robotic Systems
  - └ TX04.3 Manipulation
    - └ TX04.3.2 Grappling Technologies

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System